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ORIGINAL ARTICLE

Elderly patient's mortality and morbidity following trochanteric fracture. A hundred cases prospective study

H. Mnif*, M. Koubaa, M. Zrig, R. Trabelsi, A. Abid

Orthopedic Surgery Department, Monastir Teaching Hospital, Rue 1 Juin, 5000 Monastir, Tunisia

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KEYWORDS

Trochanteric fracture;
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Summary

Background: Trochanteric fractures are a major source of mortality, morbidity and functional impairment in the elderly. Morbidity is closely related to the degree of instability and comminution and is substantially influenced by the quality of reduction and internal fixation. Advanced age and associated co-morbidities are two decisive factors of mortality secondary to trochanteric fracture.

Objectives: This prospective study examined the epidemiological profile of trochanteric fractures and assessed mortality and morbidity with the aim of establishing management guidelines and improving prevention strategies.

Material and methods: One hundred patients were included; 60% were male. Mean age was 76 years (range, 60–96 yrs). One, or more than one, co-morbidities were present in 68% of cases. The fractures were caused by a simple fall in 90% of cases. Fractures were classified according to the criteria of Ramadier and the ones of Ender. Sixty-five percent of these fractures were unstable. A dynamic hip screw was systematically used as the standard means of internal fixation.

Results: Anatomic and functional results were analyzed in 82 patients (18 had died within the first year following fracture occurrence). Mean follow-up period was 24 months (range, 12–36 months). Bone healing was achieved in 96% of cases. There were numerous postoperative complications (four cases of thromboembolism, fourteen immobility-related complications, two infections, six secondary displacement combined to loss of fixation, four non-unions, and nine malunions). At 2 years follow-up, 28 patients had died. Mortality was strongly correlated with older age (over 90 years), associated co-morbidity and fracture instability. Good functional outcomes (72%) correlated with younger age (60–74 years), fracture stability, adequate reduction and internal fixation.

Discussion: In stable trochanteric fractures, osteosynthesis by dynamic screw-plate is more effective than alternative techniques (blade-plate, nail-plate, Ender nail or even trochanteric

* Corresponding author.

E-mail address: mnif.hich@yahoo.fr (H. Mnif).

nail). In unstable trochanteric fractures, delayed weight-bearing should be preferred to avoid mechanical complications. In fractures that are unstable or extend far below the lesser trochanter, trochanteric nailing is indicated since providing enhanced stability, but sometimes at the cost of insufficient reduction. The treatment objective should be the complete resumption of weight-bearing as early as possible with the fewest possible complications. Prevention consists in detecting and treating osteoporosis and countering the causes of falls in elderly subjects (muscular reinforcement and correction of neurosensory deficit).

Level of evidence: Level III: Prospective diagnostic study.

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Introduction

Trochanteric fracture is a major cause of mortality, morbidity and loss of functional autonomy in the elderly. Frequency rises with age, and is increasingly posing a public health issue [1,2]. The problems raised are three-fold, affecting survival, function and economics.

The present study sought:

- to examine the epidemiological profile of trochanteric fracture, assessing mortality, morbidity and risk factors;
- to establish criteria for improved pre- and post-operative management and prevention.

Material and methods

Patients

This was a prospective study of 100 consecutive trochanteric fractures. Mean patient age was 76 years, with a range of 60 to 96 years. On the WHO classification, there were 40 "young-old" patients (60 to 74 years), 54 "middle-old" (75 to 90 years) and six "old-old" (> 90 years). Sixty percent of the study population were male.

Sixty-eight patients had preexisting associated pathology, 18 having two or more (Table 1). Ninety-three had been independent before their fracture.

Household accidents were the most frequent cause, 90% of fractures being secondary to a simple fall.

Anatomopathologically, we applied two classifications:

- on the Ramadier classification [3], 35 fractures were stable and 65 unstable and comminutive;
- on the Ender classification [4], six fractures were type I, 26 type II or III, three type IV or V, 46 type VI, 12 type VII, and seven type VIII; i.e., fractures were stable or moderately unstable (I, II, III, IV and V) in 35 cases and unstable in 65.

Surgical technique

Most patients were operated on within the first week following fracture. Surgery was performed after medical preparation, at day 4 on average. Adhesive traction was provisionally implemented awaiting surgery.

General anesthesia was applied in 41% of cases and spinal anesthesia in the other 59%. Thirty-three cases required blood transfusion. Osteosynthesis systematically used a dynamic hip screw.

Non-weightbearing was imposed for a mean 55 days (range, 3 to 90 days).

Assessment of results

Anatomic results were assessed as:

- good: consolidation free of mechanical complication;
- medium: malunion;
- poor: one of the following complications—protrusion of the screw, disassembly of osteosynthesis material, or non-union.

Varus malunion was defined by a cervico-diaphyseal angle inferior to 120°, and valgus malunion superior than 150°. On profile view, the head was considered to be in retroversion when the cervico-diaphyseal angle was below 0°. Finally, the fracture was considered to be impacted when overlapping the superior internal cortex by more than 1 cm on frontal X-ray.

Functional results were assessed by the Merle d'Aubigné-Postel (PMA) functional score in terms of hip pain, mobility and stability [5].

Statistical analysis used SPSS 11 software for Student paired means, Chi² and Fisher tests, with a significance threshold set at $p < 0.05$.

Table 1 Pathologies associated with trochanteric fracture.

Associated pathology	Number of cases
Cardiovascular pathology	
High blood-pressure	27
Other	13
Diabetes	18
Neurological pathology	7
Pleuro-pulmonary pathology	4
Neoplastic pathology	3
Other general pathology	21
Total	93

Table 2 Functional results and mortality by age-group.

Age-group (yrs)	60–74	75–89	> 90	Total
N	40	54	6	100
Mean PMA score	16.5 (8–18)	15.3 (7–18)	10 (7–13)	15.5 (7–18)
Death at 3 months (%)	2 5	8 14.8	1 16.6	11 11
Death at 4–12 months (%)	—	4 7.4	3 50	7 7
Death at 13–24 months (%)	—	8 14.8	2 33.4	10 10
Total (%)	2 5	20 37	6 100	28 28

Table 3 Functional results according to Merle d'Aubigné Hip rating with regards to fracture type.

	Excellent	Very good	Good	Fair	Mediocre	Poor	Total
Cervico-trochanteric	1	—	3	—	1	—	5
Simple pertrochanteric	5 21%	4 17%	10 42%	1 4%	1 4%	3 12%	24 100%
Complex pertrochanteric	2 5.5%	10 28%	11 30%	6 17%	1 2.5%	6 17%	36 100%
Intertrochanteric	—	—	—	3	—	—	3
Subtrochanteric	1	—	4	—	—	—	5
Trochantero-diaphyseal	1	4	3	—	—	1	9
Total	10	18	31	10	3	10	82

Results

Anatomo-functional results could be analyzed in 82 patients. The remaining 18 died within the first 12 months following fracture occurrence. Mean follow-up for the series was 24 months (range, 12–36 months). Bone consolidation was achieved in 96% of cases, generally between the 2nd and 3rd month.

Anatomic results were good in 77% of cases, medium in 11% and poor in 12%.

Merle D'Aubigné functional scores were excellent in 12% of cases, very good in 22%, good in 38%, fair in 12%, mediocre in 4% and poor in 12%.

Analyzing functional result according to age showed a trend for the poorest results to be obtained in "old-old"

rather than younger patients, although the difference was not significant ($p > 0.05$; Table 2).

Poor results were more frequently associated with unstable, inter-trochanteric and complex pertrochanteric fractures ($p = 0.014$; Table 3).

Several complications occurred, in the early course in 19 cases and late in 21. Secondary and late complications significantly worsened the functional result ($p = 0.046$; Table 4).

Early complications comprised:

- four thromboembolisms, including two pulmonary embolisms;
- 14 decubitus complications with three broncho-pulmonary infections, five urinary tract infections, six buttock ulcers and one early deep infection.

Table 4 Functional results according to Merle d'Aubigné Hip rating with regards to secondary complications.

	Excellent	Very good	Good	Fair	Mediocre	Poor	Total
Free of complications	6	16	27	5	2	5	61
Infection	—	—	—	1	—	1	2
Disassembly	—	—	—	1	—	2	3
Screw displacement	—	—	1	2	—	—	3
Non-union	1	—	—	1	1	1	4
Malunion	3	2	3	—	—	1	9
Total	10	18	31	10	3	10	82

Secondary and late complications comprised:

- two late deep infections on consolidated fractures, requiring reintervention and removal of osteosynthesis device;
- three cases of disassembly of osteosynthesis material;
- three cases of cortical screw displacement on very porotic bone;
- four non-unions (3 aseptic), and nine malunions (5 varus, 3 valgus, 1 impaction) well-tolerated functionally.

Mortality at 2 years of follow-up was 28%, comprising: 3% immediate postoperative (1st week), 8% early postoperative (16 days to 3 months), 7% between the 4th and 12th months, and 10% between the 12th and 24th months.

Mortality risk factors comprised:

- age, 2-year mortality being 5% for the “young-old” as compared to respectively 25% and 100% for the “middle-old” and “old-old” ($p = 0.008$; Table 2);
- associated pathology, 82% of deaths being associated with medical pathology ($p < 0.05$);
- fracture instability, associated with 68% of deaths. Gender, on the other hand, did not affect mortality.

Discussion

The percentage of elderly persons in the population is constantly increasing worldwide, and the rate of proximal femoral fracture likewise. In 1990, the population over the age of 65 was estimated at 323 million, and is expected to reach 1,555 million by 2050 [6,7]. The number of proximal femoral fractures is expected to increase from 1.7 million in 1990 to 6.25 million in 2025. These figures give some idea of the global scale of the problem [1,2,6].

In Tunisia, the population was 9.4 million in 1999 and is expected to reach 11.3 million in 2010 and 13 million by 2025. The percentage of those aged 60 and over is similarly growing, from 5.8% in 1975 to 9% in 1999, according to the National Statistics Institute.

In the region studied in 1998, the population numbered 400,000, with 3,250 aged 60 or over. The annual number of proximal femoral fractures was 160 in our institution, with an estimated incidence of five per thousand, close to the worldwide figure [8,9].

Present management attitudes favor closed or open osteosynthesis [10,11]. Open osteosynthesis theoretically has the advantage of enabling anatomic reduction, and the drawback of further devascularizing the fracture site with an increased risk of hemorrhage and sepsis. Moreover, it fails to provide good stabilization of unstable fractures, and thus to allow systematic and safe early resumption of weight-bearing [7,12–14]. Closed osteosynthesis is a satisfactory attitude towards trochanteric fractures as a whole. It employs flexible Ender nails or trochanteric nails [15–17] and has the advantage of being quick and, especially, of entailing little hemorrhage and respecting the fracture hematoma. Trochanteric nails represent a real revolution in proximal femur osteosynthesis, enabling treatment of the whole range of trochanteric fractures. The excellent mechanical behavior of this device allows

almost systematic early resumption of weight-bearing [18].

A number of comparative studies have shown dynamic screw-plates to be more effective than blade-plates or nail-plates [19], Ender nails [20] or even trochanteric nails [21,26] for trochanteric fracture osteosynthesis.

This advantage, however, does not apply to unstable trochanteric fractures or those with sub-trochanteric extension. In these cases, trochanteric nails are the implant of choice, having the theoretical advantage over dynamic plate-screws of limiting fracture impaction [22]. On the other hand, it is not always straightforward to control fracture reduction in closed surgery and reduction defects in varus and rotation as well as shortening have been reported with trochanteric nailing [23].

Other complications may also arise with trochanteric nailing:

- displacement or perforation of the cortico-cephalic screw was reported in 2% to 6% of cases [7,23–25]. These figures are comparable to those found with dynamic screw-plates;
- the nail may be subject to fatigue fracture, especially in pathological or unstable fractures with a subtrochanteric extension;
- per- or postoperative fracture, usually following breakage at the nail insertion or femoral metaphysis, may destabilize osteosynthesis and was reported in 5 to 11% of cases [7,24,25,26];
- proximal femur fracture, secondary to mild trauma, occurs in up to 12% of cases [7,17,25–28].

After a proximal femoral fracture, elderly subjects are liable to decompensate their risky preexisting pathological state. The associated complications most frequently encountered are broncho-pulmonary, thromboembolic, infectious, cardiac, urinary tract infection and stroke [29]. In the current series such complications affected 19% of cases, in agreement with the various reports in the literature [14,30]. Mechanical complications relating to osteosynthesis may worsen functional status in these fragile patients. Several factors have been implicated in the occurrence of such complications:

- poor previous physiological state, especially in the “old-old”;
- unstable, comminutive fracture;
- poor reduction and/or osteosynthesis.

Secondary complications are mainly mechanical: disassembly of material, displacement of cortical screw, non-union, malunion and sometimes femoral head necrosis. They affected 21% of the current series and were related to poor functional results.

It is now agreed that proximal femoral fracture is a significant factor of increased mortality in the elderly. Mortality is estimated at 20% to 40% in the various published series [31–39]. In the present series, it was 18%, compared to 4.5% in the over-60s population as a whole: i.e., four-fold higher than for the reference population. Excess mortality persists during the 2nd year of postoperative survival, two-fold higher than for the reference population. As of the 3rd year,

it becomes comparable to that of the reference population: patients who have survived 2 years after distal femur fracture may be considered to be cured, with the same survival expectancy as in the reference population.

The most frequently implicated factors in excess mortality are advanced age [40,41], preexisting pathology [31,35,42] and male gender [43,44]. Mortality is increased by delayed surgery [35]. The relation between mortality and type of osteosynthesis is controversial [33,45,46]. Hommel et al. [1] determined the factors directly increasing mortality at 12 months post-fracture: advanced age, male gender, and associated pathology delaying surgery (including psychiatric pathology such as dementia).

Given these high rates of morbidity and mortality, proximal femoral fracture represents a major public health issue. Its main causes are falls and bone fragility. Prevention strategies should therefore be implemented rapidly, especially since well-validated methods now enable proximal femoral fracture risk to be detected from clinical risk-factor assessment and CT, Dual Energy X-ray Absorptiometry, US and biochemical assessment of bone fragility [6,7,9,29,39,40,42].

Preventing falls may be primary, in a subject who has never had a fall, or secondary, in a subject who has had one or several falls. Prevention is founded on correcting neurosensory deficits, on functional rehabilitation, and on physical education programs [6,29,35,45,47–49]. The latter seek to strengthen the muscles and train endurance and balance, thus reducing the risk of falls and fracture [37,47–49].

Preventing bone fragility [8,9,37] is possible at all ages, but should be reinforced in post-menopausal women by early or late hormone replacement therapy, possibly associated to vitamin/calcium supplementation, and in the elderly by correcting calcium and vitamin D deficiency, associated to antiresorption therapy in case of low bone mineral density. The overall aim of all these measures is to grow old free of fracture.

Conclusion

With the increase of age-related pathologies such as osteoporosis, proximal femoral fracture raises a problem of public health. Management is and should be multidisciplinary and multifaceted.

Preventing falls is the first line, related to improved knowledge of the physical environment and also to the associated pathologies. Surgery is the second line, and must be performed without error and in detail: i.e., perfect fracture reduction associated to stable osteosynthesis. Surgery is primordial, to avoid decompensation of associated pathologies and decubitus complications, which may often be fatal. Respecting all of these principles and facets is the only guarantee of successful management and of a consequent reduction in morbidity and mortality.

Conflicts of interest

No conflicts of interest.

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